International Journal of Agricultural Science and Research (IJASR)
ISSN(P): 2250-0057; ISSN(E): 2321-0087
Vol. 7, Issue 2, Apr 2017, 217-222

TRANS STELLAR •Journal Publications •Research Consultancy

EVALUATION OF FERTILIZER USE EFFICIENCY IN RICE VARIETIES AS INFLUENCED BY COMBINATION OF PLANT DENSITY AND FERTILIZER LEVELS

O SAMPATH[1] & A SRINIVAS[2]

[1]*Department of Agronomy, College of Agriculture, Prof. Jayashankar Telangana State Agricultural University, Rajendranagar, India*

[2]*PJTSAU, Department of Agronomy, College of Agriculture, Prof. Jayashankar Telangana State Agricultural University, Rajendranagar, India*

ABSTRACT

A field experiment was conducted on a sandy clay loam soil at college farm of Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, Rajendranagar, Hyderabad, Telangana during the kharif seasons of2014 and 2015 to study the rice varieties and combination of plant densities and fertilizers for evaluating fertilizer use efficiency under late sown condition. Among the varieties, MTU 1010 performed superior to Pradyumna and Rajendra. Higher fertilizer use efficiency was noticed in P_3 (15 cm × 10 cm) in combination with F_1 (111-32-45, N, P_2O_5& K_2O) under late sown condition.

KEYWORDS: Jayashankar Telangana, Rajendranagar Hyderabad & MTU 1010

Received: Jan 06, 2017; **Accepted:** Feb 09, 2017; **Published:** Mar 07, 2017; **Paper Id.:** IJASRAPR201730

Original Article

INTRODUCTION

Rice (*Oryza sativa* (L.)) is one of the most important staple food crops in the world. However, more than 90 per cent of rice is consumed in Asia, where it is a staple food for a majority of the population, including the 560 million hungry people in the region (Mohanty, 2013). In Asia, more than two billion people are getting 60-70 per cent of their energy requirement from rice and its derived products. Among the rice growing countries, India has the largest area (42.27 m ha) and it is the second largest producer (105.24 m t) of rice next to China (144 m t). With an average productivity of 2.49 t ha^{-1}, though increasing marginally, but is still well below the world's average yield of 4.36 t ha^{-1} (FAOSTAT Database, 2014). At the current population growth rate (1.5 %), the rice requirement of India by 2025 would be around 125 m t (Kumar *et al*., 2009). The importance of continuing to develop new rice varieties to guarantee India's food security and support the region's economic development needs no special emphasis. Varieties play a vital role in maximizing of yield by improving the input use efficiency. Optimum plant spacing ensures plants to grow properly both in their aerial and underground parts through utilization of solar radiation and nutrients, therefore proper manipulation of planting density may lead to increase in the economic yield of transplanted rice. Rice yields generally depend on its genetic potential, agro climatic conditions and management practices. Among various agronomic factors crop nutrition is of paramount importance. Fertilizer is one of the efficient means of increasing rice yields. Rice yield per unit area per unit time is dependent on adequate fertilization. Balanced fertilization right from the very beginning of crop growth is utmost essential to achieve better harvest of crop (Singh and Namdeo, 2004). As about 40 percent of yield increase is accounted against fertilizer use,

the fertilizer recommendations should be matched to the basic soil fertility, season, target yield, climate etc. (Dakshina Murthy *et al*., 2015). Excessive use fertilizer nutrient implies increase in cost and decrease of returns and risk of environmental pollution. On the other hand under use of nutrients depress the scope for increasing the present level of nutrients to the economically optimum level to exploit production potential to a larger extent (Singh *et al*., 2001).

MATERIAL AND METHODS

Field experiment was conducted during the *kharif* season of 2014 and 2015 at Agricultural College Farm, Rajendranagar, Hyderabad. The experimental site was geographically situated at an altitude of 542.6 m above mean sea level, on 17^0 19^1 N latitude and 78^0 24^1E longitude. It comes under Southern Telangana zone of Telangana. The soil was sandy clay loam in texture, neutral in reaction(pH 7.2) with0.49% of organic matter, with low available nitrogen (180.8 kg ha^{-1}), high available phosphorus (38.6 kg ha^{-1}) and potassium (312 kg ha^{-1}).

The experiments were laid out in a split plot design with three replications. Three varieties MTU 1010, Rajendra and Pradyumna as main plot treatments, three plant densities (P_1: 20 x 20 cm, $P_{2:}$ 15 x 15 cm and $P_{3:}$15 x 10 cm), three fertilizer levels ($F_{1:}$111-32-45, $F_{2:}$153-59-68 and $F_{3:}$195-86-90) as sub plot treatments.

The fertilizer levels, 111-32-45 kg NPK ha^{-1}, 153-59-68kg NPK ha^{-1} and 195-86-90kg NPK ha^{-1} were applied as 50 per cent N, full dose of P and 50 per cent K at the time of transplanting. Nitrogen was applied as per the treatments in 3 split doses as basal 50% and at active tillering and panicle initiation stages 25% each. The remaining half of potassium was applied at panicle initiation stage.

The efficiency with which the applied nutrient is used by the crop towards grain production was evaluated through partial factor productivity.

The partial factor productivity (Pfp) from applied nutrient is useful measure of nutrient use efficiency because it provide integrative index that quantifies total economic output related to utilization of all nutrient resource in the system (Cassmen*et al*., 1996). It is the ratio of grain yield to the applied nutrient (kg grain kg^{-1} N) and was computed as follows.

$$\text{Partial factor productivity (Pfp)} = \frac{\text{Grain yield (kg ha}^{-1}\text{)}}{\text{Total amount of nutrient applied (kg ha}^{-1}\text{)}}$$

RESULTS AND DISCUSSIONS

Partial Factor Productivity of Nitrogen

The mean nitrogen partial factor productivity of MTU 1010 (N Pfp) (kg grain kg^{-1} N) was 40.17, 41.71 and 40.94 during 2014, 2015 and in pooled means. The partial factor productivity of nitrogen significantly influenced by varieties and plant density in combination with fertility levels during both the years study (Table 2).

MTU 1010 recorded significantly higher nitrogen partial factor productivity (40.17, 41.71 and 40.94 kg grain kg^{-1} N in 2014, 2015 and in pooled means, respectively) as compared to Pradyumna (35.33, 36.40 and 35.86 kg grain kg^{-1} N in 2014, 2015 and in pooled means, respectively). The magnitude of such difference in the N Pfp was perhaps due to higher grain yield with same amount of input nitrogen.

Data pertaining to nitrogen partial factor productivity of rice revealed that, higher nitrogen partial factor

productivity was noticed in P_3 (15 cm × 10 cm) in combination with F_1(111-32-45, N, P_2O_5 & K_2O) and was significantly superior to P_2 (15 cm × 15 cm) and P_1 (20 cm × 20 cm), which in turn recorded significantly the lowest nitrogen partial factor productivity(Table 2).This might be due to higher requirement by the crop at lower rates of application. Nutrient use efficiency for plant growth and grain production irrespective of the nutrient decreased with the increase in fertility levels (Sudhakar*et al*., 2006), (Mahendra Singh Pal *et al*., 2008).

These results are in agreement with the findings of Priyadarsini and Prasad (2003), Thakur, *et al.*, (2013) and Malla Reddy and Padmaja (2013).

The interaction effect on N partial factor productivity of rice during both years of study was found significant among varieties, plant density in combination with fertility levels. **Partial Factor Productivity of phosphorus**

MTU 1010 recorded significantly higher phosphorus partial factor productivity (115.28, 119.74 and 117.51 kg grain kg^{-1} P_2O_5 in 2014, 2015 and in pooled means, respectively) as compared to Pradyumna (101.16, 104.27 and 102.71 kg grain kg^{-1} P_2O_5 in 2014, 2015 and in pooled means, respectively).The lowest phosphorus partial factor productivity (95.53, 98.23 and 96.88 kg grain kg^{-1} P_2O_5 in 2014, 2015 and in pooled means, respectively) was observed in Rajendra.

The magnitude of such difference in the phosphorus Pfp was perhaps due to higher grain yield with same amount of input phosphorus. This might be due to higher requirement by the crop at lower rates of application. Nutrient use efficiency for plant growth and grain production irrespective of the nutrient decreased with the increase in fertility levels (Sudhakar*et al*., 2006).

Data pertaining to phosphorus partial factor productivity of rice revealed that, higher phosphorus partial factor productivity was noticed in P_3 (15 cm × 10 cm) in combination with F_1 (111-32-45, N, P_2O_5& K_2O) and was significantly superior to P_2 (15 cm × 15 cm) and P_1 (20 cm × 20 cm), which in turn recorded significantly the lowest phosphorus partial factor productivity (Table 2).

These results are in agreement with the findings of Priyadarsini and Prasad (2003) and Thakur, *et al.*, (2013).

The interaction effect on phosphorus partial factor productivity of rice during both years of study was found significant among varieties, plant density in combination with fertility levels.

Partial Factor Productivity of potassium

Similarly, MTU 1010 recorded significantly higher potassium partial factor productivity (93.10, 96.68 and 94.89 kg grain kg^{-1} K_2O in 2014, 2015 and in pooled means, respectively) as compared to Pradyumna (81.83, 84.32 and 83.07 kg grain kg^{-1} K_2O in 2014, 2015 and in pooled means, respectively). The magnitude of such difference in the potassium Pfp was perhaps due to higher grain yield with same amount of input potassium.

Data pertaining to potassium partial factor productivity of rice revealed that, higher potassium partial factor productivity was noticed in P_3 (15 cm × 10 cm) in combination with F_1 (111-32-45, N, P_2O_5& K_2O) and was significantly superior to P_2 (15 cm × 15 cm) and P_1 (20 cm × 20 cm), which in turn recorded significantly the lowest potassium partial factor productivity (Table 2). This might be due to higher requirement by the crop at lower rates of application. Nutrient use efficiency for plant growth and grain production irrespective of the nutrient decreased with the increase in fertility levels (Sudhakar*et al*., 2006).

These results are in agreement with the findings of Priyadarsini and Prasad (2003) Thakur, *et al.*, (2013).

The interaction effect on potassium partial factor productivity of rice during both years of study was found significant difference among varieties, plant density in combination with fertility levels.

REFERENCES

1. *Cassman, K. G., Gines, C. G., Dizon, M. A., Samson, M. I and Alcantar, J. M. 1996. Nitrogen use efficiency in tropical lowland rice systems: contribution from indigenous and applied nitrogen. Field Crop Research.47: 1-12.*
2. *Dakshina Murthy, K. M., Upendra Rao, A., Vijay, D and Sridhar, T. V. 2015. Effect of levels of nitrogen, phosphorus and potassium on performance of rice. Indian Journal of Agricultural Research.49 (1):83-87.*
3. *Kumar, R. M., Surekha, K., Padmavathi, Ch., Rao, L. V. S., Latha, P. C., Prasad, M. S., Babu, V. R., Ramprasad, A. S., Rupela, O.P., Goud, P. V., Raman, P. M., Somashekar, N., Ravichandran, S., Singh, S.P and Viraktamath, B.C. 2009. Research experiences on System of Rice Intensification and future directions. Journal of Rice Research.2: 61-73.*
4. *Mahendra Singh Pal, Zhang Guoping and Chen Jinxin.2008. Nitrogen uptake and N use efficiency in hybrid and common rice as influenced by nitrogen fertilization. Oryza. 45 (2): 156-159.*
5. *Malla Reddy, M and Padmaja, B. 2013.Response of rice (Oryza Sativa) varieties to nitrogen under aerobic and flooded conditions. Indian Journal of Agronomy.*58(4): 500-505.
6. *Mohanty, S. 2013. Trends in global rice consumption. Rice Today: 44-45.*
7. *Priyadarsini, J and Prasad, P. V. N. 2003. Evaluation of Nitrogen Use Efficiency of different rice varieties supplied with organic and inorganic sources of nitrogen.The Andhra Agricultural Journal. 50(3&4):207-210.*
8. *Singh, H. P., Sharma, K. L., Ramesh, V. and Mandal, U. K. (2001). Nutrient mining in different agro climatic zones of Andhra Pradesh. Fertilizer news 46(8):29-42.*
9. *Singh, R. K and Namdeo, K. N. 2004. Effect of fertility levels and herbicides on growth, yield and nutrient uptake of direct-seeded rice (Oryzasativa). Indian Journal of Agronomy. 49 (1): 34-36.*
10. *Sudhakar, P. C., Singh, J. P., Yogeshwarsingh and Raghavendra singh.2006. Effect of graded fertility levels and silicon sources on crop yield, uptake and nutrient use efficiency in rice (Oryza sativa). Indian Journal of Agronomy.51(3):186-188.*
11. *Thakur, A. K., Sreelatha Rath and Krishna Gopal Mandal. 2013. Differential response of system of rice intensification (SRI) and conventional flooded rice management methods to application of nitrogen fertilizer. Plant and soil.221-227.*

APPENDICES

Table 1: Grain Yield of Rice as Influenced by Rice Varieties in Relation to Combination of Planting Densities and Fertilizer Levels During *kharif* 2014 and 2015

Treatments	Grain yield (Kg ha^{-1})		
	2014	2015	Pooled
Main treatments (Varieties)			
V_1- MTU 1010	5891	6113	6002
V_2-Rajendra	4885	5022	4954
V_3- Pradyumna	5195	5351	5273
SEm±	57	63	60
CD (0.05)	223	247	235
Sub Treatments(Combination of Planting Density and Fertilizer Levels)			
T_1-P_1F_1	4092	4239	4165

Table 1: Contd.,

T_2-P_1F_2	4499	4660	4579
T_3-P_1F_3	4685	4817	4751
T_4-P_2F_1	4986	5141	5064
T_5-P_2F_2	5378	5571	5474
T_6-P_2F_3	5613	5814	5714
T_7-P_3F_1	5826	6034	5930
T_8-P_3F_2	6341	6532	6437
T_9-P_3F_3	6494	6647	6570
SEm±	78	78	78
CD (0.05)	222	222	221
Interaction			
SEm± (Vx T)	139	142	140
CD (0.05)	NS	NS	NS
SEm± (TxV)	135	135	135
CD (0.05)	NS	NS	NS

Plant Density			**Fertilizers (N,P2O5,K2O kg/ha)**		
P_1	: 25 hills m^{-2} (20x20 cm)		F_1	: 111-32-45	
P_2	: 44 hills m^{-2} (15x15 cm)		F_2	: 153-59-68	
P_3	: 66 hills m^{-2} (15x10 cm)		F_3	: 195-86-90	

Table 2: Partial Factor Productivity of NPK in rice as Influenced by Rice Varieties in Relation to Combination of Plant Densities and Fertilizer Levels During *kharif* 2014 and 2015

Treatments	Nitrogen Pfp			Phosphorus Pfp			Potassium Pfp		
	2014	2015	Pooled	2014	2015	Pooled	2014	2015	Pooled
Main Treatments (Varieties)									
V_1- MTU 1010	40.17	41.71	40.94	115.28	119.74	117.51	93.10	96.68	94.89
V_2-Rajendra	33.30	34.24	33.77	95.53	98.23	96.88	77.17	79.35	78.26
V_3- Pradyumna	35.33	36.40	35.86	101.16	104.27	102.71	81.83	84.32	83.07
SEm±	0.39	0.44	0.41	1.11	1.26	1.19	0.90	1.01	0.96
CD (0.05)	1.53	1.71	1.62	4.37	4.96	4.66	3.54	3.98	3.75
Sub Treatments (Combination of Plant Density and Fertilizer Levels)									
T_1-P_1F_1	36.86	38.19	37.53	127.88	132.46	130.17	90.93	94.20	92.56
T_2-P_1F_2	29.40	30.46	29.93	76.25	78.98	77.61	66.16	68.52	67.34
T_3-P_1F_3	24.02	24.70	24.36	54.47	56.01	55.24	52.05	53.52	52.79
T_4-P_2F_1	44.92	46.32	45.62	155.82	160.67	158.25	110.81	114.25	112.53
T_5-P_2F_2	35.15	36.41	35.78	91.15	94.42	92.79	79.09	81.92	80.50
T_6-P_2F_3	28.79	29.82	29.30	65.27	67.61	66.44	62.37	64.60	63.49
T_7-P_3F_1	52.49	54.36	53.42	182.06	188.58	185.32	129.46	134.10	131.78
T_8-P_3F_2	41.45	42.69	42.07	107.48	110.71	109.09	93.25	96.06	94.66
T_9-P_3F_3	33.30	34.09	33.69	75.51	77.29	76.40	72.15	73.85	73.00
SEm±	0.51	0.52	0.51	1.49	1.56	1.52	1.18	1.21	1.19
CD (0.05)	1.45	1.47	1.45	4.25	4.42	4.32	3.35	3.43	3.39
Interaction									
SEm± (Vx T)	0.92	0.95	0.93	2.68	2.84	2.75	2.13	2.22	2.17
CD (0.05)	2.79	2.92	2.85	8.12	8.68	8.38	6.46	6.81	6.62
SEm± (TxV)	0.88	0.90	0.89	2.59	2.69	2.63	2.04	2.09	2.06
CD (0.05)	2.50	2.55	2.52	7.35	7.66	7.49	5.81	5.95	5.86

Plant Density			**Fertilizers (N,P2O5,K2O kg/ha)**	
P_1	: 25 hills m^{-2} (20x20 cm)		F_1	: 111-32-45
P_2	: 44 hills m^{-2} (15x15 cm)		F_2	: 153-59-68
P_3	: 66 hills m^{-2} (15x10 cm)		F_3	: 195-86-90